

Topics



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ADVANTAGES OF STEEL AS A STRUCTURAL MATERIAL

High Strength

The high strength of steel per unit of weight means that the weight of structures will be small. This fact is of great importance for long-span bridges, tall buildings, and structures situated on poor foundations.

Uniformity

The properties of steel do not change appreciably with time, as do those of a reinforced-concrete structure.

Elasticity

Steel behaves closer to design assumptions than most materials because it follows Hooke's law up to fairly high stresses. The moments of inertia of a steel structure can be accurately calculated, while the values obtained for a reinforced-concrete structure are rather indefinite.

Prepared by Eng.Maged Kamel.

Permanence

Steel frames that are properly maintained will last indefinitely. Research on some of the newer steels indicates that under certain conditions no painting maintenance whatsoever will be required.

Ductility

The property of a material by which it can withstand extensive deformation without failure under high tensile stresses is its *ductility*. When a *mild* or *low-carbon* structural steel member is being tested in tension, a considerable reduction in cross section and a large amount of elongation will occur at the point of failure before the actual fracture occurs. A material that does not have this property is generally unacceptable and is probably hard and brittle, and it might break if subjected to a sudden shock.

Prepared by Eng.Maged Kamel.

DISADVANTAGES OF STEEL AS A STRUCTURAL MATERIAL

Corrosion

Most steels are susceptible to corrosion when freely exposed to air and water, and therefore must be painted periodically. The use of weathering steels, however, in suitable applications tends to eliminate this cost.

Fireproofing Costs

Although structural members are incombustible, their strength is tremendously reduced at temperatures commonly reached in fires when the other materials in a building burn. Many disastrous fires have occurred in empty buildings where the only fuel for the fires was the buildings themselves. Furthermore, steel is an excellent heat conductor—nonfireproofed steel members may transmit enough heat from a burning section or compartment of a building to ignite materials with which they are in contact in adjoining sections of the building. As a result, the steel frame of a building may have

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Fatigue

Another undesirable property of steel is that its strength may be reduced if it is subjected to a large number of stress reversals or even to a large number of variations of tensile stress. (Fatigue problems occur only when tension is involved.) The present practice is to reduce the estimations of strength of such members if it is anticipated that they will have more than a prescribed number of cycles of stress variation.

Brittle Fracture

Under certain conditions steel may lose its ductility, and brittle fracture may occur at places of stress concentration. Fatigue-type loadings and very low temperatures aggravate the situation. Triaxial stress conditions can also lead to brittle fracture.

to be protected by materials with certain insulating characteristics, and the building may have to include a sprinkler system if it is to meet the building code requirements of the locality in question.

Susceptibility to Buckling

As the length and slenderness of a compression member is increased, its danger of buckling increases. For most structures, the use of steel columns is very economical because of their high strength-to-weight ratios. Occasionally, however, some additional steel is needed to stiffen them so they will not buckle. This tends to reduce their economy.

Prepared by Eng.Maged Kamel.